

# Utilization of Earth Observation Imagery by the National Agricultural Statistics Service



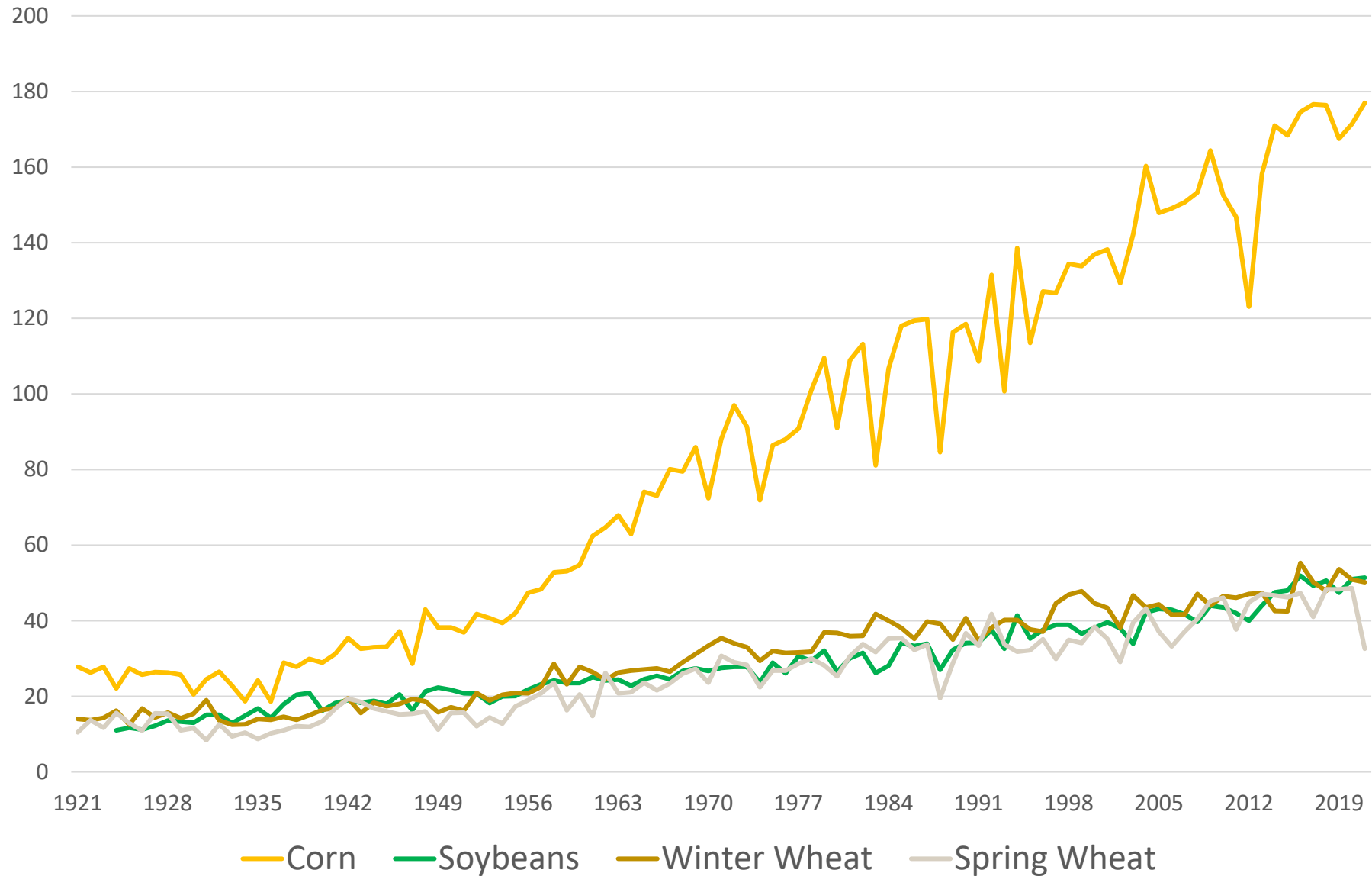
**United States Department of Agriculture**  
National Agricultural Statistics Service

**Dave Johnson** | [david.m.johnson@usda.gov](mailto:david.m.johnson@usda.gov)

**June 16, 2022** | *virtual from Silver Spring, Maryland*




# USA yield trends (bushels/acre)



# National Agricultural Statistics Service (NASS)

Provider of timely, accurate, and useful statistics in service to U.S. agriculture



**2001 Wildlife Damage Survey**

7.7 Percent of Crop Value Lost to Deer and Geese


\$17.2 million of corn, soybeans and wheat to deer or geese during 2001. Farmers losing 7.7 percent of the crop value to deer and geese. Soybeans 4 to loss, totaling \$9.1 million, 11 percent. Corn losses were \$6.6 million, 5.6 percent. Deer damage resulted in losses of \$13.6 million, 6.1 percent, and 1.6 percent.

4.6 million bushels. Corn losses were 3.2 million bushels, soybean losses accounted for 0.6 million bushels. Production losses to deer were 4.6 million bushels.

to deer were most severe in Central and Western Maryland, while geese damage was more severe in the Eastern Shore. Corn yield losses of 9.6 bushels per acre and 7.4 bushels per acre were reported, respectively. The Lower Eastern Shore reported the highest soybean losses.

was reported deer or geese damage to one or more crops. Damage was reported to corn, 58 percent of farms growing soybeans and 27 percent of farms with wheat.

Crop	Acres Harvested	Harvested Yield (bushels)	Average Yield Loss (bushels)	Production Loss (bu)
Corn	5,200	114,375	7.4	40,700
Soybeans	3,200	30,720	3.2	10,230
Wheat	200	45,200	2.3	460
Soybeans	125,000	39,200	9.7	1,201,200
Corn	82,000	38,200	3.4	360,780
Soybeans	38,300	63,300	3.3	126,390
Corn	29,800	112,200	4.7	149,280
Soybeans	43,200	38,200	3.3	142,860
Wheat	16,000	57,200	0.9	14,400
Corn	157,000	119,200	5.1	860,700
Soybeans	232,000	39,200	2.4	556,800
Wheat	86,600	64,200	1.1	85,150



**USDA NEWS RELEASE**  
NATIONAL AGRICULTURAL STATISTICS SERVICE  
United States Department of Agriculture • Washington, DC 20250  
Ag Statistics Hotline: (800) 727-9540 • [www.nass.usda.gov](http://www.nass.usda.gov)

Contact: Ellen Dougherty  
Jeff Geuder

**USDA FORECASTS RECORD-SETTING CORN CROP FOR 2007**

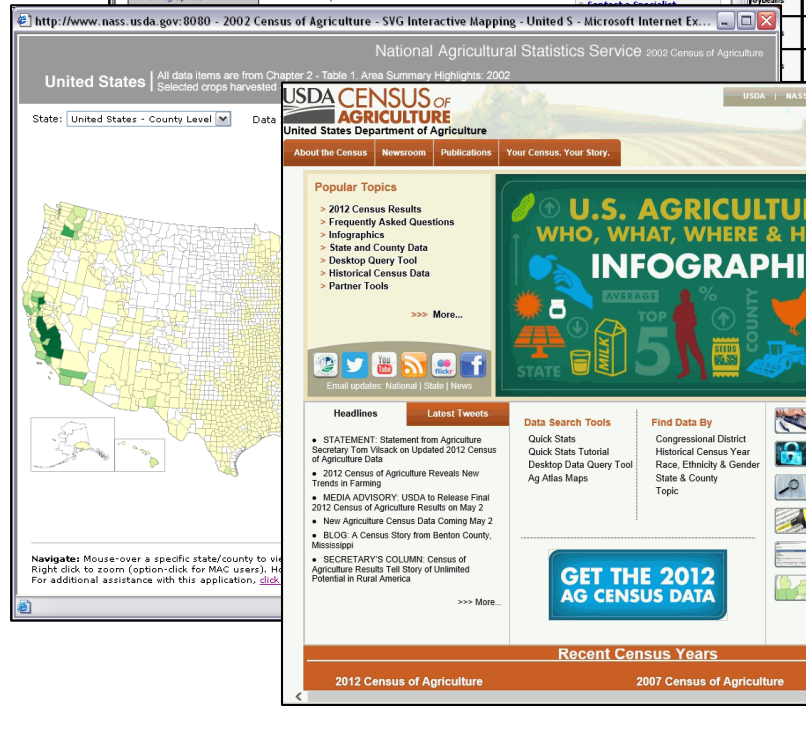
Washington, Aug. 10, 2007 – U.S. farmers are expected to produce the largest corn crop in 2007, according to the *Crop Production* report released today by the United States Department of Agriculture's National Agricultural Statistics Service (NASS). Corn production is expected to reach 13.1 billion bushels, 10.6 percent above the previous record of 11.8 billion bushels set in 2004.

Based on conditions as of August 1, corn yields are expected to average 160.4 bushels per acre, up 3.7 bushels from last year. This would be second highest corn yield behind the 160.4 bushels per acre produced in 2004. Growers are expected to harvest 160.4 million acres of corn for grain, the most since 1933 and 14.8 million more acres than in 2004.

Yield forecasts are higher than last year across the Great Plains, central and eastern Corn Belt, Ohio Valley, Tennessee Valley, Southeast and Atlantic States. Meanwhile, hot, dry conditions led to lower expected yields across much of the West, particularly in the Pacific Northwest, Idaho, and California.

NASS forecasts 2007 soybean production at 2.63 billion bushels, down 1.2 percent from last year's record high of 3.19 billion bushels. Yields are expected to average 44.2 bushels per acre, down 1.2 bushels from last year.

All cotton production is estimated at 17.3 million 480-pound bales, down 1.2 percent from last year's 17.6 million bales. Yield is expected to average 783 pounds per acre, down 1.2 percent from last year's 788 pounds per acre.



**USDA CENSUS OF AGRICULTURE**  
National Agricultural Statistics Service  
United States Department of Agriculture

State: United States - County Level

Popular Topics


- 2012 Census Results
- Frequently Asked Questions
- Infographics
- State and County Data
- Desktop Query Tool
- Historical Census Data
- Partner Tools

Headlines

- STATEMENT: Statement from Agriculture Secretary Tom Vilsack on Updated 2012 Census of Agriculture Data
- 2012 Census of Agriculture Reveals New Trends in Farming
- MEDIA ADVISORY: USDA to Release Final 2012 Census of Agriculture Results on May 2
- New Agriculture Census Data Coming May 2
- BLOG: A Census Story from Benton County, Mississippi
- SECRETARY'S COLUMN: Census of Agriculture Results Tell Story of Unlimited Potential in Rural America

Recent Census Years

- 2012 Census of Agriculture
- 2007 Census of Agriculture



**Acreage**

ISSN: 1949-1522

Released June 30, 2021, by the National Agricultural Statistics Service (NASS), Agricultural Statistics Board, United States Department of Agriculture (USDA).

**Special Note**

Estimates of the portion of the total planted acreage that was left to be planted when the survey was conducted, are published on page 6. These estimates are based on data provided by respondents who were contacted between May 29 and June 17. Corn left to be planted was 2.18 million acres. Soybeans left to be planted was 9.84 million acres.

NASS implemented program changes beginning with the 2019 crop year. As a result of these changes, the Principal Crop totals before and after the changes are not fully comparable. Full details of the program changes can be found at [https://www.nass.usda.gov/Surveys/Program\\_Review/index.php](https://www.nass.usda.gov/Surveys/Program_Review/index.php).

**Corn Planted Acreage Up 2 Percent from 2020**  
**Soybean Acreage Up 5 Percent**  
**All Wheat Acreage Up 5 Percent**  
**All Cotton Acreage Down 3 Percent**

Corn planted area for all purposes in 2021 is estimated at 92.7 million acres, up 2 percent or 1.87 million acres from last year. Compared with last year, planted acreage is expected to be up or unchanged in 28 of the 48 estimating States. Area harvested for grain, at 84.5 million acres, is up 2 percent from last year.

Soybean planted area for 2021 is estimated at 87.6 million acres, up 5 percent from last year. Compared with last year, planted acreage is up or unchanged in 28 of the 29 estimating States.

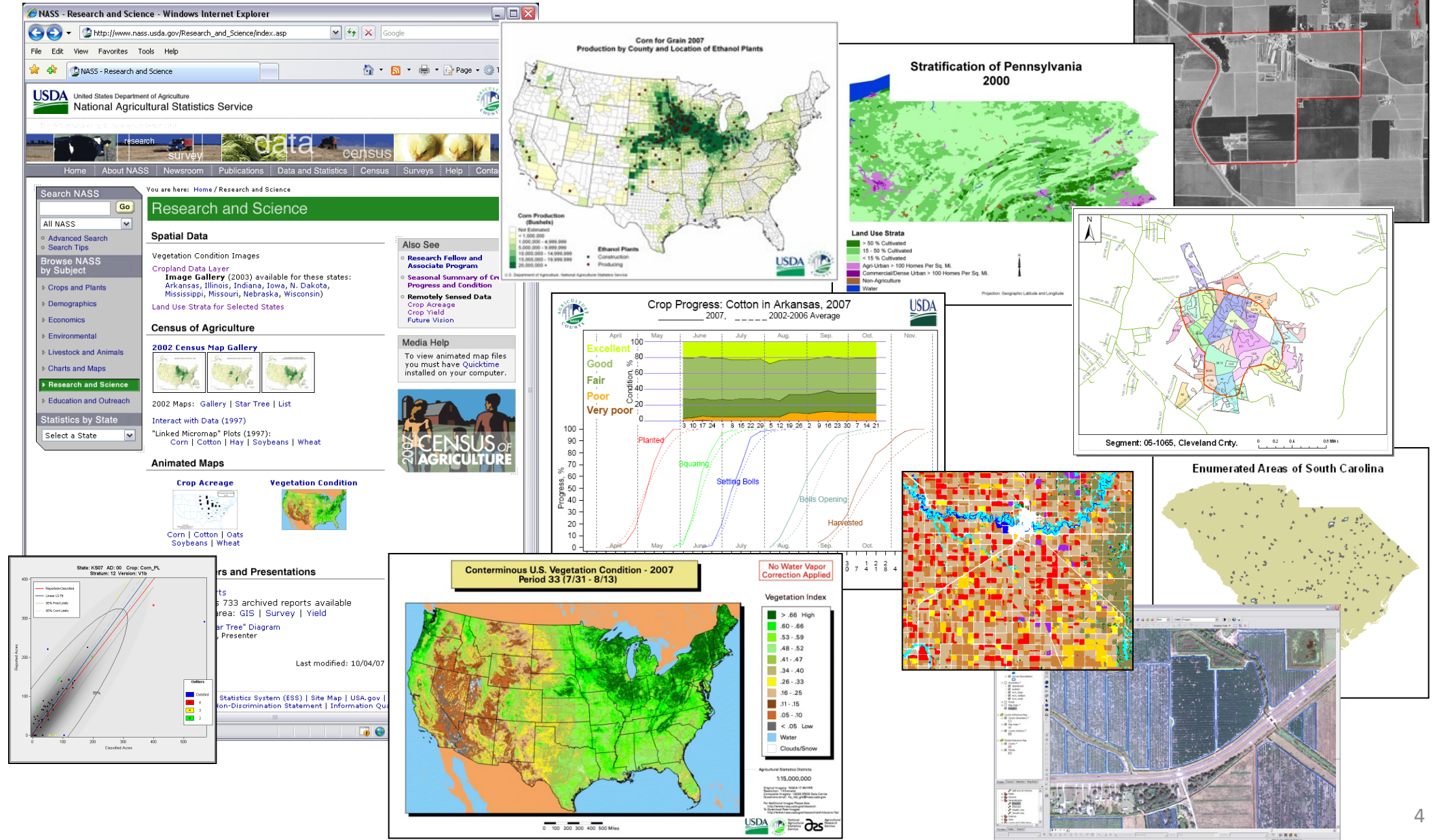
All wheat planted area for 2021 is estimated at 46.7 million acres, up 5 percent from 2020. This represents the fourth lowest all wheat planted area since records began in 1919. The 2021 winter wheat planted area, at 33.7 million acres, is up 11 percent from last year and up 2 percent from the previous estimate. Of this total, about 23.6 million acres are Hard Red Winter, 6.59 million acres are Soft Red Winter, and 3.50 million acres are White Winter. Area expected to be planted to other spring wheat for 2021 is estimated at 11.6 million acres, down 5 percent from 2020. Of this total, about 10.8 million acres are Hard Red Spring wheat. Durum planted area for 2021 is expected to total 1.48 million acres, down 12 percent from the previous year.

All cotton planted area for 2021 is estimated at 11.7 million acres, down 3 percent from last year. Upland area is estimated at 11.6 million acres, down 3 percent from 2020. American Pima area is estimated at 142,000 acres, down 30 percent from 2020.



# NASS Research and Development Division

## Geospatial Information Group – All things map-based



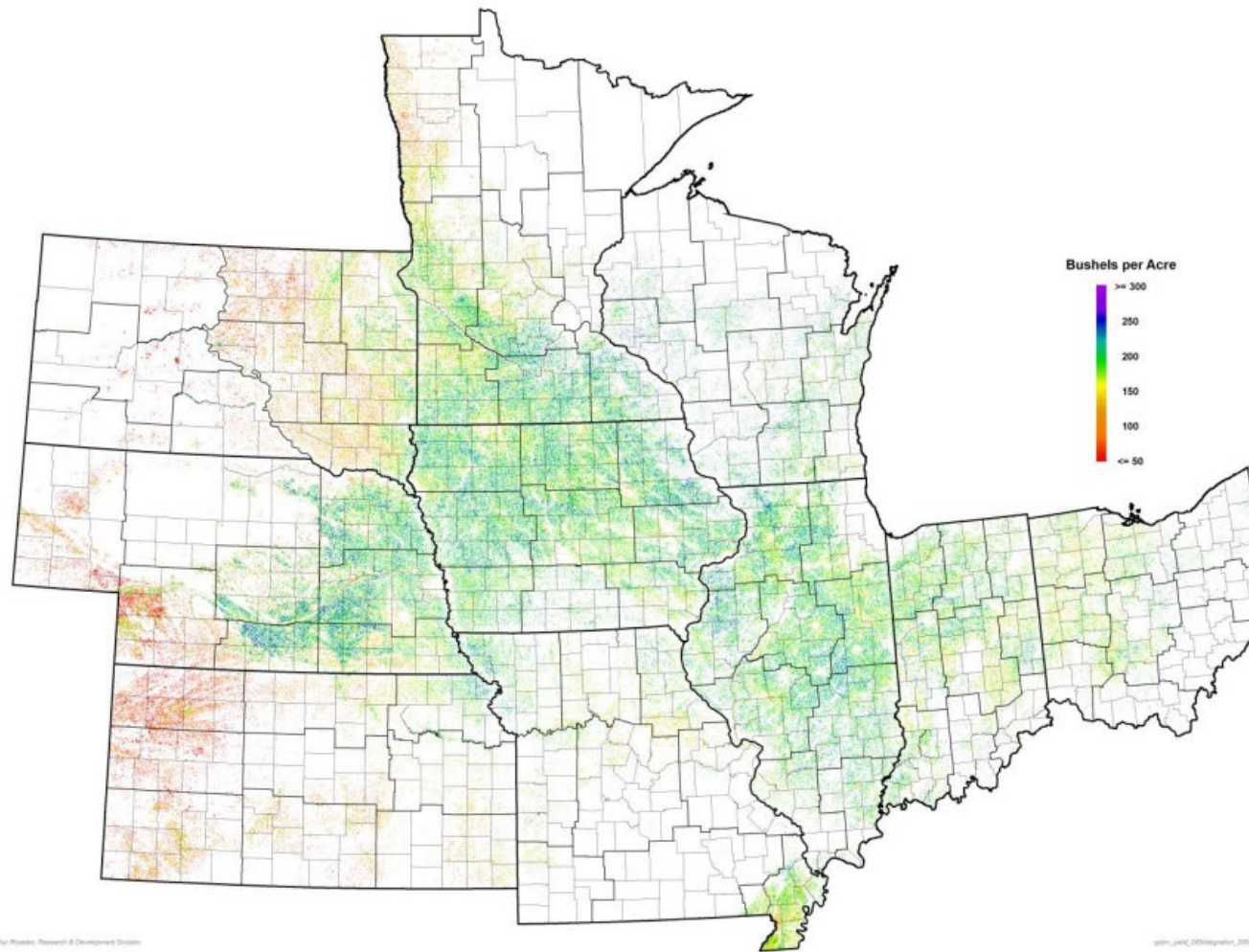




# October 2021 Corn NASA Terra MODIS Modeled Yield



S



## Crop Production

ISSN: 1936-3737

Released October 12, 2021, by the National Agricultural Statistics Service (NASS), Agricultural Statistics Board, United States Department of Agriculture (USDA).

### Special Note

Each October, NASS considers revisions to planted and harvested acreage for canola, corn, dry edible beans, sorghum, soybeans, sugarbeets, and sunflower. Updates are based on all available data, including the latest certified acreage data from the Farm Service Agency (FSA). All States in the estimating program for these crops were subject to review and updating. NASS previously reviewed corn, sorghum, soybeans, and sugarbeets in September due to the completeness of this season's data for these crops and published updates at that time. No additional changes were made for corn, sorghum, or soybeans this month. Detailed estimates are found on pages 6, 9, 11, 14, 17, 22, and 23.

**Corn Production Up Slightly from September Forecast**  
**Soybean Production Up 2 Percent**  
**Cotton Production Down 3 Percent**  
**Orange Production Down 12 Percent from Last Season**

**Corn** production for grain is forecast at 15.0 billion bushels, up slightly from the previous forecast and up 6 percent from 2020. Based on conditions as of October 1, yields are expected to average 176.5 bushels per harvested acre, up 0.2 bushel from the previous forecast and up 5.1 bushels from last year. After a thorough review of all available data, acreage estimates are unchanged from last month. Total planted area, at 93.3 million acres, is unchanged from the previous estimate, but up 3 percent from the previous year. Area harvested for grain, forecast at 85.1 million acres, is unchanged from the previous forecast but up 3 percent from the previous year.

**Soybean** production for beans is forecast at a record 4.45 billion bushels, up 2 percent from the previous forecast and up 5 percent from 2020. Based on conditions as of October 1, yields are expected to average 51.5 bushels per harvested acre, up 0.9 bushel from the previous forecast and up 0.5 bushel from 2020. After a thorough review of all available data acreage estimates are unchanged from last month. Total planted area, at 87.2 million acres, is unchanged from the previous estimate, but up 5 percent from the previous year. Area harvested for beans, forecast at 86.4 million acres, is unchanged from the previous forecast but up 5 percent from the previous year.

**All cotton** production is forecast at 18.0 million 480-pound bales, down 3 percent from the previous forecast, but up 23 percent from 2020. Based on conditions as of October 1, yields are expected to average 871 pounds per harvested acre, down 24 pounds from the previous forecast but up 24 pounds from 2020. Upland cotton production is forecast at 17.7 million 480-pound bales, down 3 percent from the previous forecast but up 26 percent from 2020. Pima cotton production is forecast at 353,000 bales, up 5 percent from the previous forecast but down 35 percent from 2020. All cotton area harvested is forecast at 9.92 million acres, unchanged from the previous forecast, but up 20 percent from 2020.



**MODIS**, since collected daily, central to most regional crop yield modeling research and applications

Transition to **VIIRS** underway

MODIS Web

https://modis.gsfc.nasa.gov

# MODIS

MODERATE RESOLUTION IMAGING SPECTRORADIOMETER

About Data Tools Science Team Images News Related Sites MODARCH

Learn More About Today's Image

Iran's Caspian Sea coastline and Alborz mountains helped raise dust inland in late November,

[Continue Reading](#)

### Data

The MODIS Data section contains everything from ATBDs to Product Descriptions to Product ordering information, including from Direct Broadcast data providers. Visit the Data section for more information.

[Learn More About MODIS Data](#)

### News

[LP DAAC Announces Release of MODIS Version 6 Net Evapotranspiration Products](#)

[Release of NASA MEaSUREs CAMEL 5 km Products Announced By LP DAAC](#)

[View More MODIS News](#)

### Tools

The MODIS Tools section has a complete listing of web-based tools that can be used to access a wide variety of MODIS Data, along with an array of links and a summary of each tool.

[Learn More About MODIS Tools >>](#)

### Disciplinary Teams

#### Atmosphere

MODIS Atmosphere

#### Land

MODIS Land

#### Ocean

Ocean Color

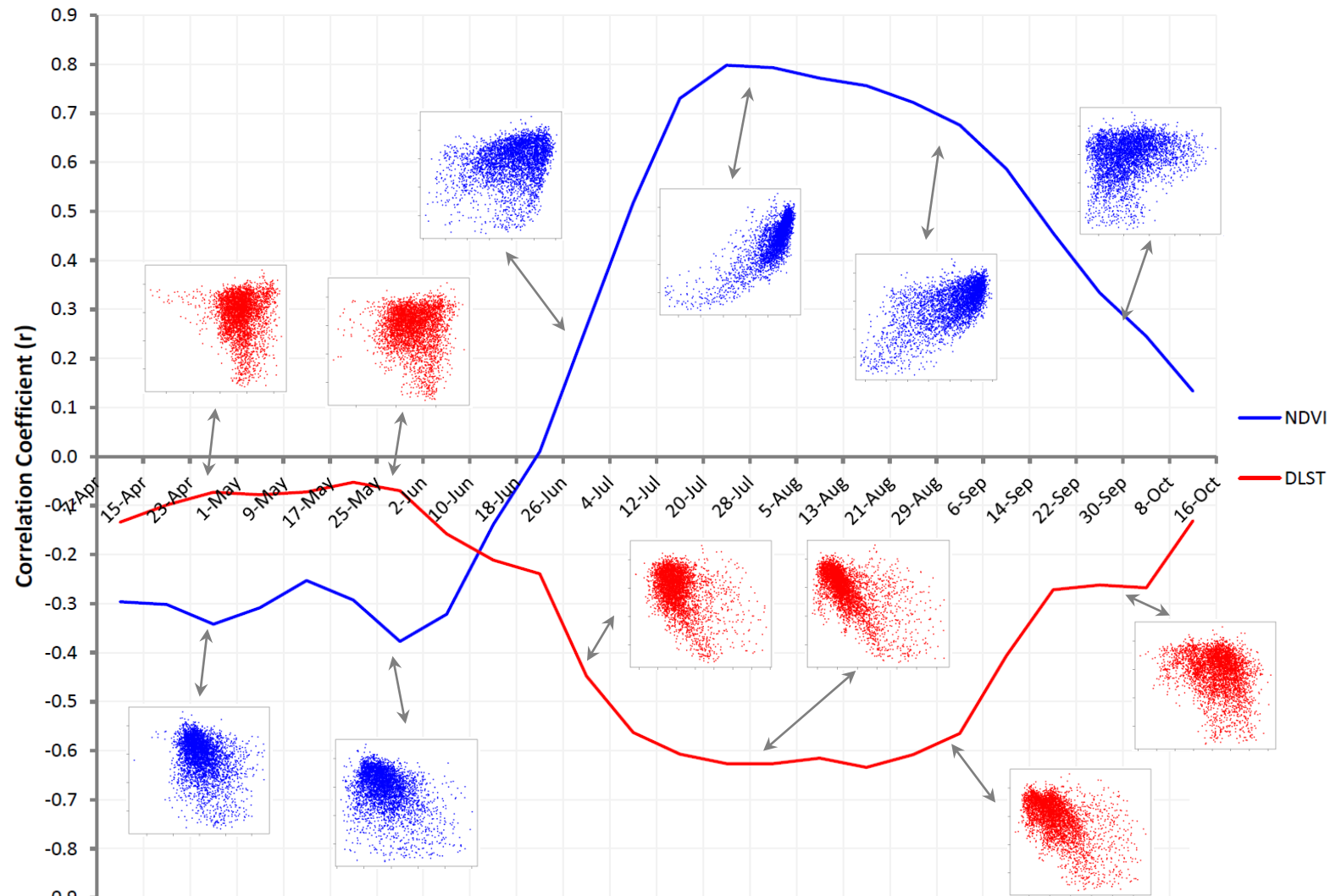
#### Calibration

MODIS Calibration Support Team



# NDVI and DLST time-series correlations (r)

Variable vs Yield Dependence - Corn Example

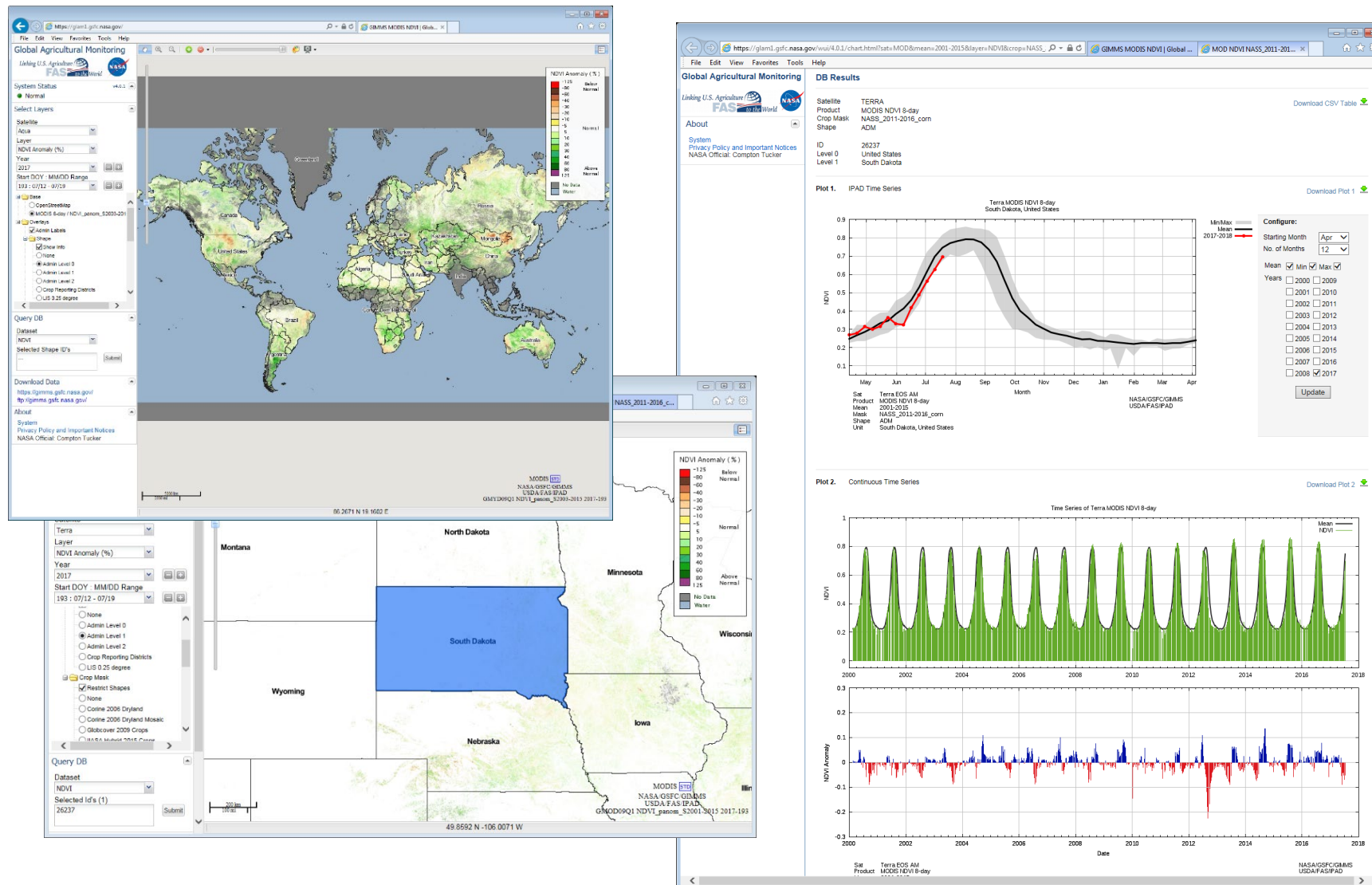


Each point in scatterplot represents a county



# USDA Foreign Agricultural Service/NASA GLAM

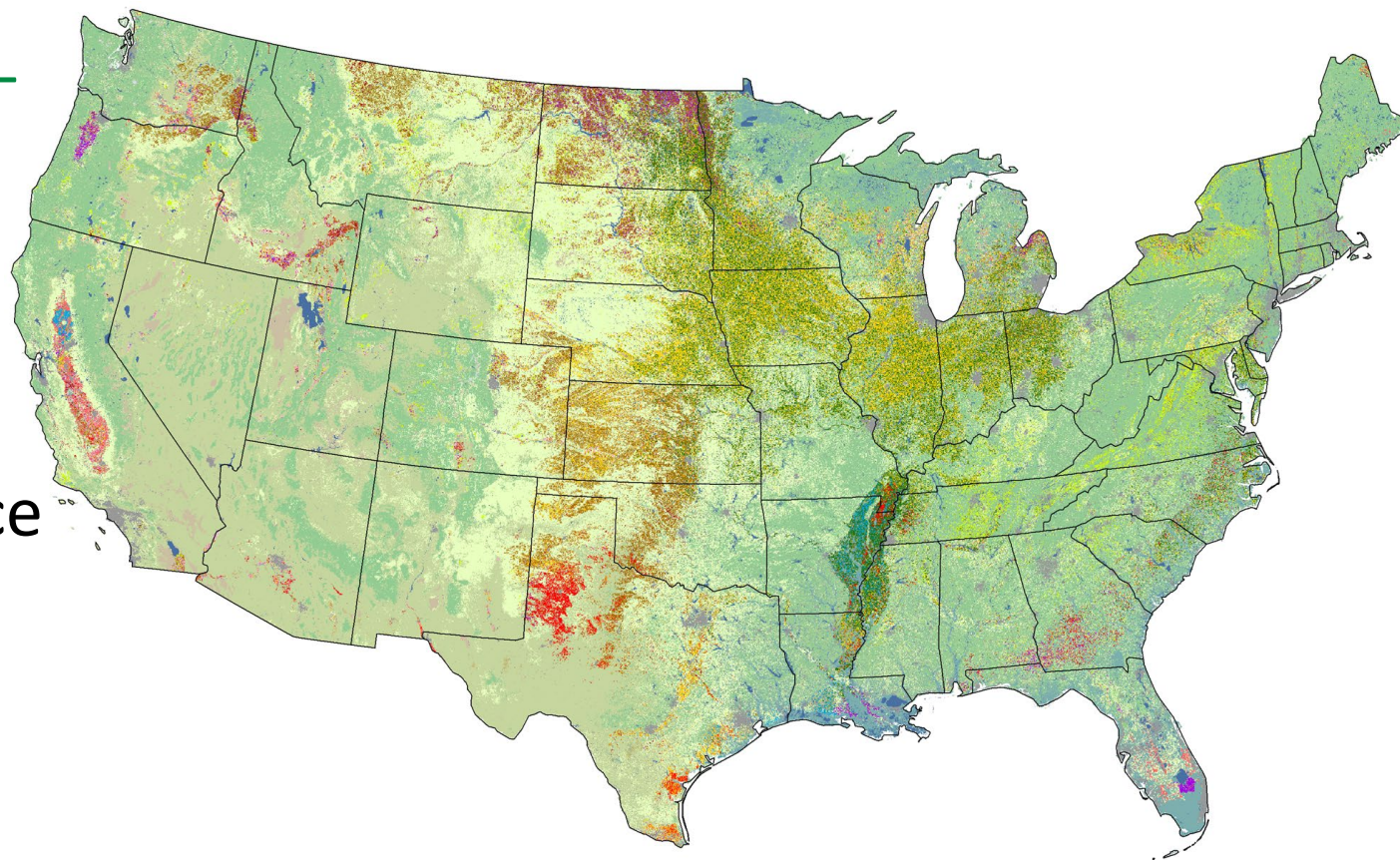
<https://glam1.gsfc.nasa.gov/>



Highly already customized tool for MODIS time series analysis, display, and data access

# Cropland Data Layer

- Annually produced, **30m, crop-specific land cover** dataset
- Captures planted area
- **Freely available** and open to the public
- **Timeframe:** National scale since 2008
  - 2021 CDL released in early February
  - 2022 already being conceived



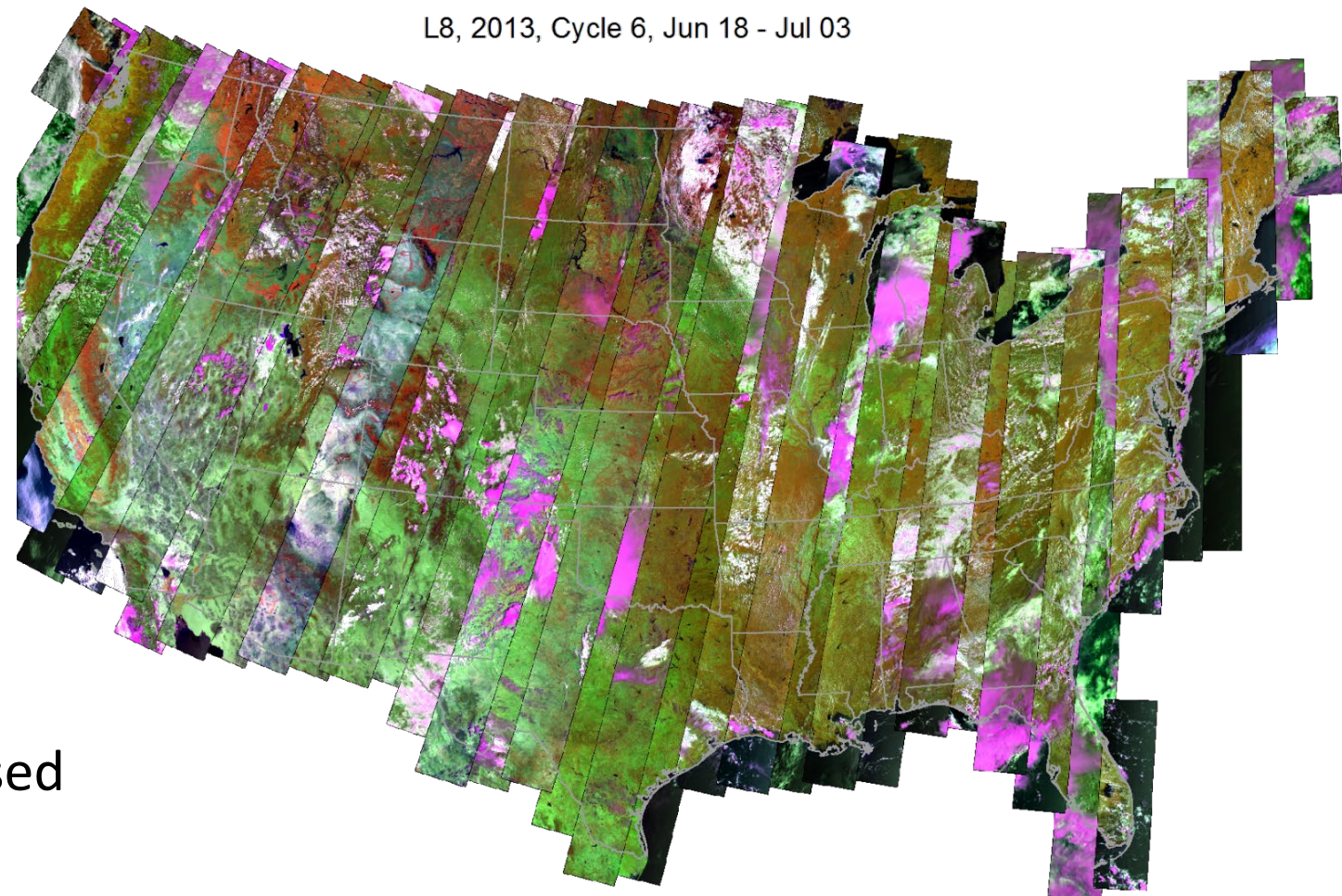
**Propose: produce supplemental and unbiased acreage estimates for major commodities**

CropScape: <https://nassgeodata.gmu.edu/CropScape/>



# Input Imagery

- Optical satellite imagery acquired throughout the growing season
  - April through November
- Sensors currently used
  - Landsat 8 & 9
  - Sentinel-2a/b
- Imagery resampled to 30m spatial resolution
  - Blue and thermal bands not used



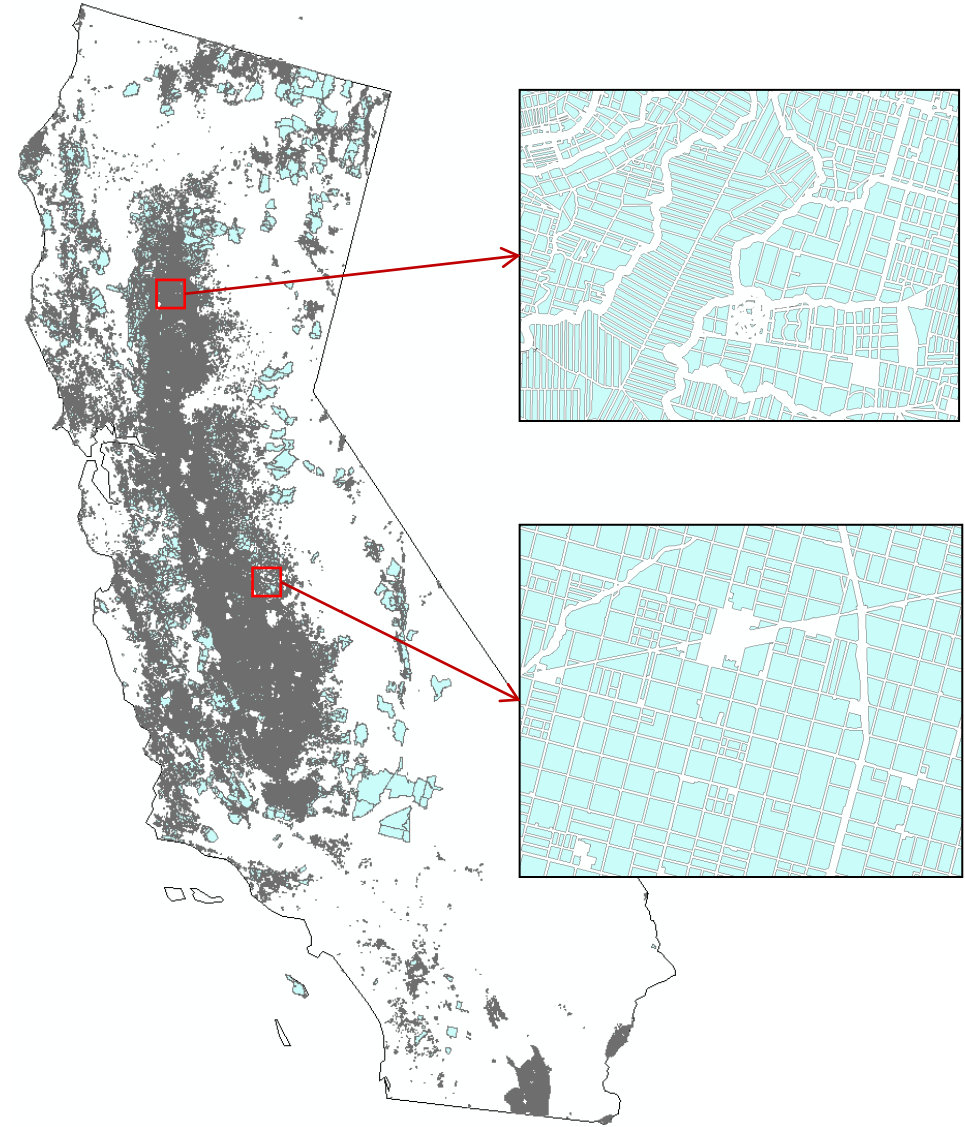
**Capture mostly cloud free imagery over the growing season**



# Ground Reference Data: field polygons

## Common Land Unit (CLU)

- Pre-digitized field locations
- GIS-ready polygon shapefiles
- Managed at state-level
- No crop info natively, but for many fields we can access crop type information via governmental farmer program
- Certain states have millions of polygons
- Preparatory work done using ArcGIS



# CDL Methodology

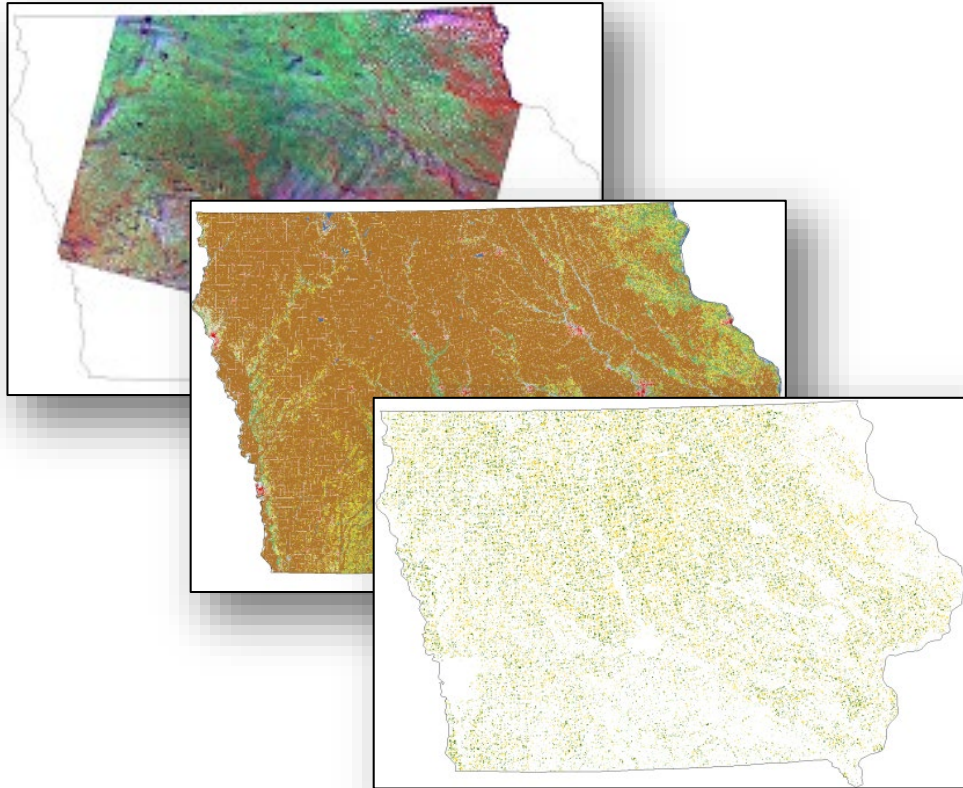
Input Imagery, Ancillary Data, & Reference Data



Sampling, Decision Trees, & Classifier



Output Maps & Metadata



ArcGIS (polygon handling)

Hexagon ERDAS Imagine (raster handling)

```

class and attribute definitions [hypothyroid.names]
training cases to be analyzed [hypothyroid.data]
test cases [hypothyroid.test]

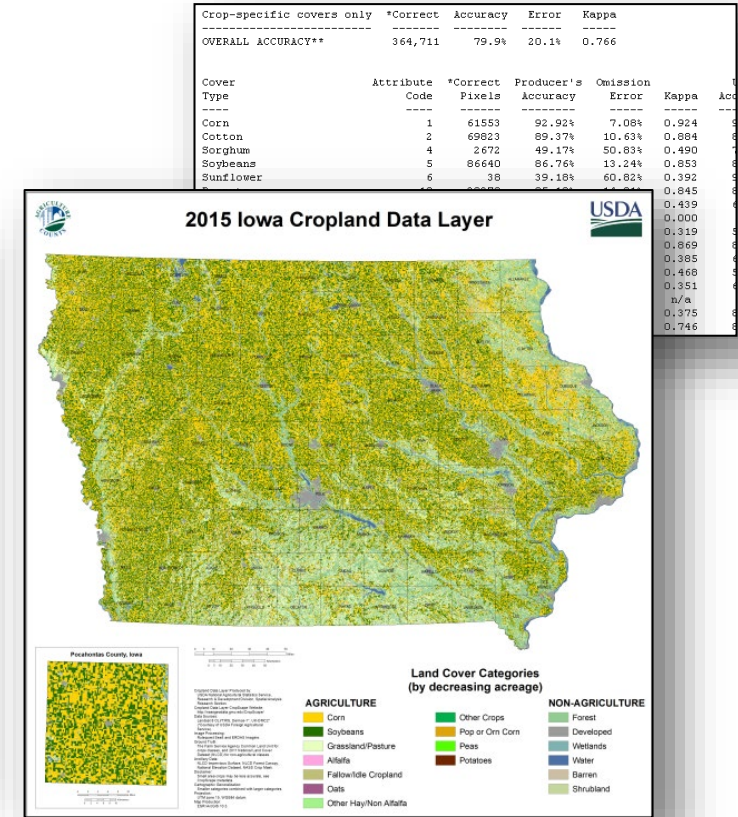
misclassification
decision tree classifier
ruleset classifier
output file [hypothyroid.ruleset]

Decision tree:
band146 > 0:
...band146 > 17:
...band146 > 48:
...band146 <= 76:
...band146 > 56: 123 (1224/184)
band146 <= 56:
...band06 > 702: 123 (7/1)
band06 <= 702:
...band146 <= 50:
...band146 > 4581:
...band140 <= 59: 122 (102/30)
band140 > 59: 123 (6)
band142 <= 4581:
...band146 > 49: 123 (93/40)
band146 <= 49:
...band28 <= 416: 122 (68/32)
band28 > 416: 123 (6/1)
band146 > 50:
...band70 <= 109:
...band111 <= 140: 123 (582/156)
band111 > 140: 122 (24/8)
band70 > 109:
...band64 <= 187: 1 (2/1)
band64 > 187:
...band68 <= 233: 123 (6/2)
band68 > 233: 122 (21/8)
band146 > 76:
...band84 > 121: 123 (4)
band84 <= 121:
...band146 <= 83:
...band20 <= 591: 124 (318/133)
band20 > 591: 123 (17/5)
band146 > 83:
...band15 <= 129: 124 (149/1)
band15 > 129:
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band142 > 4701: 123 (4)
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...band146 <= 88:
...band109 <= 122: 124 (149/14)
band109 > 122: 123 (2)
band146 > 88:
...band12 <= 404: 124 (208/1)
band12 > 404:
...band09 <= 181: 123 (3)
band09 > 181: 124 (21)
band146 <= 49:
...band113 <= 91:
...band113 > 91:
...band21 <= 134: 122 (8/1)
band21 > 134:
...band08 <= 665: 123 (30/12)
band08 > 665: 122 (13/2)

```

Rulequest See5.0

(boosted decision trees)



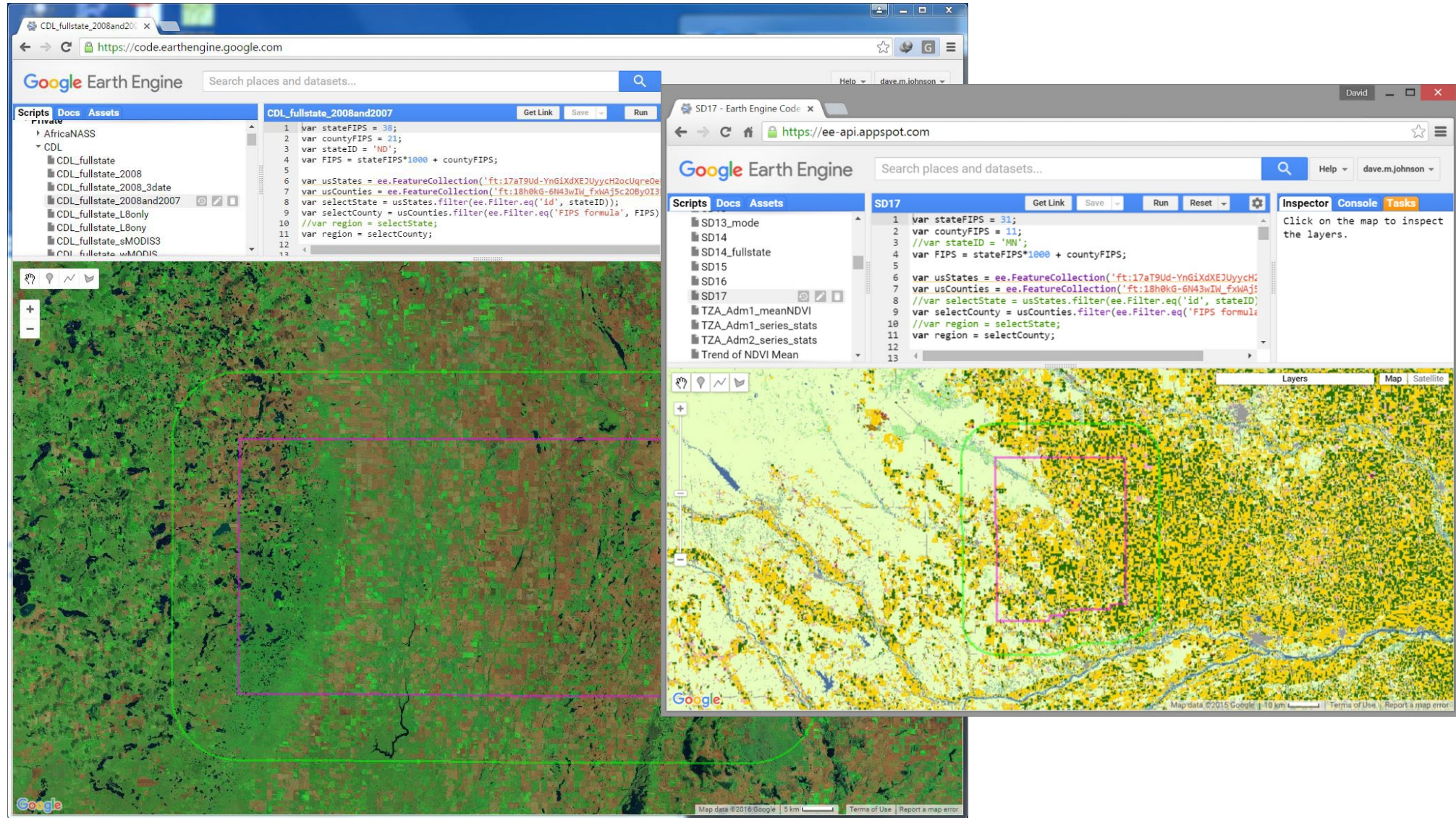
Internet Portals

All tasks performed and managed on a local area Windows-based network



# Paradigm shift underway toward “Cloud” Computing

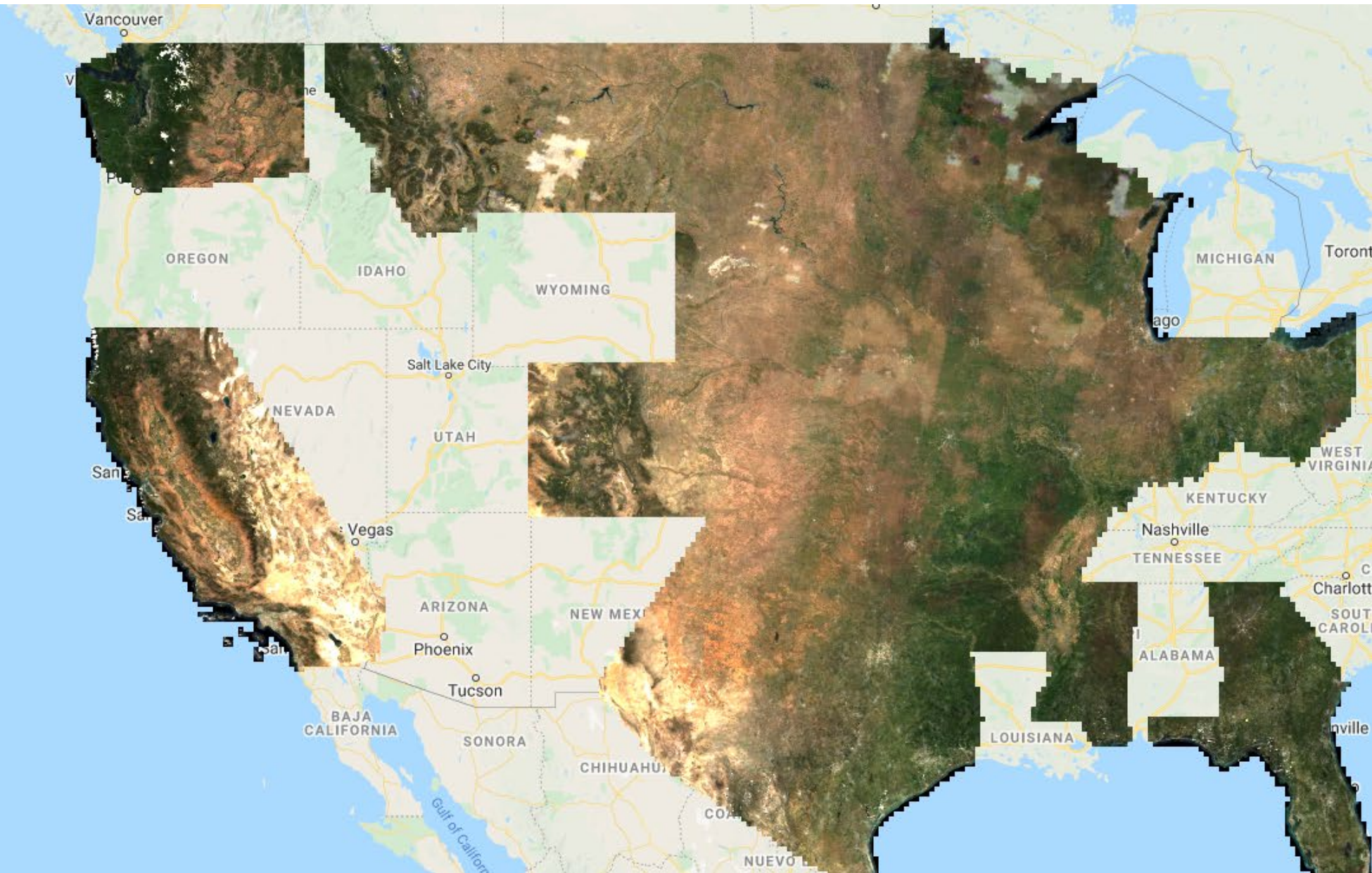
*e.g. Google Earth Engine*



The whole pertinent MODIS, Landsat, Sentinel-2 archives staged for analysis

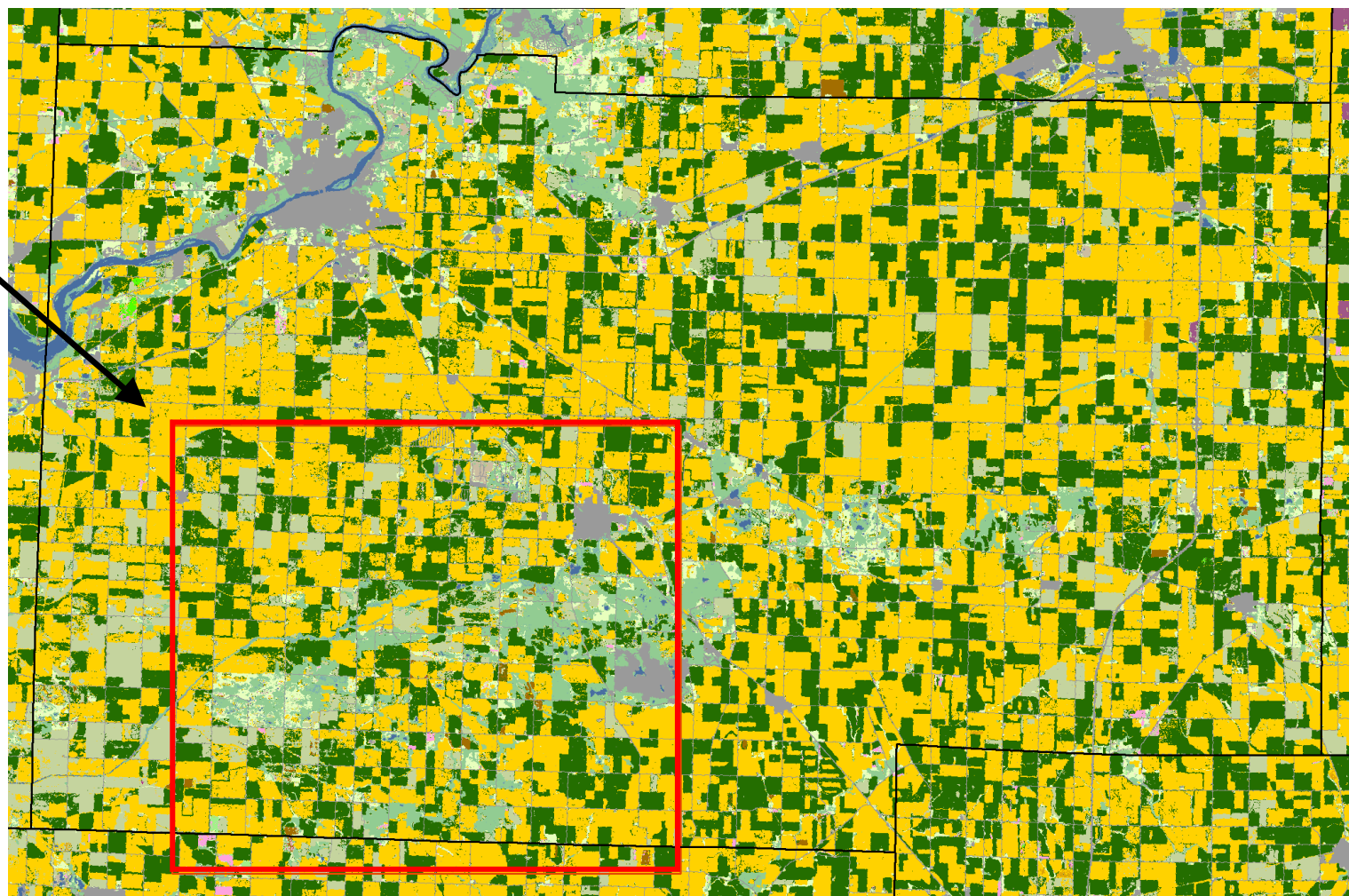
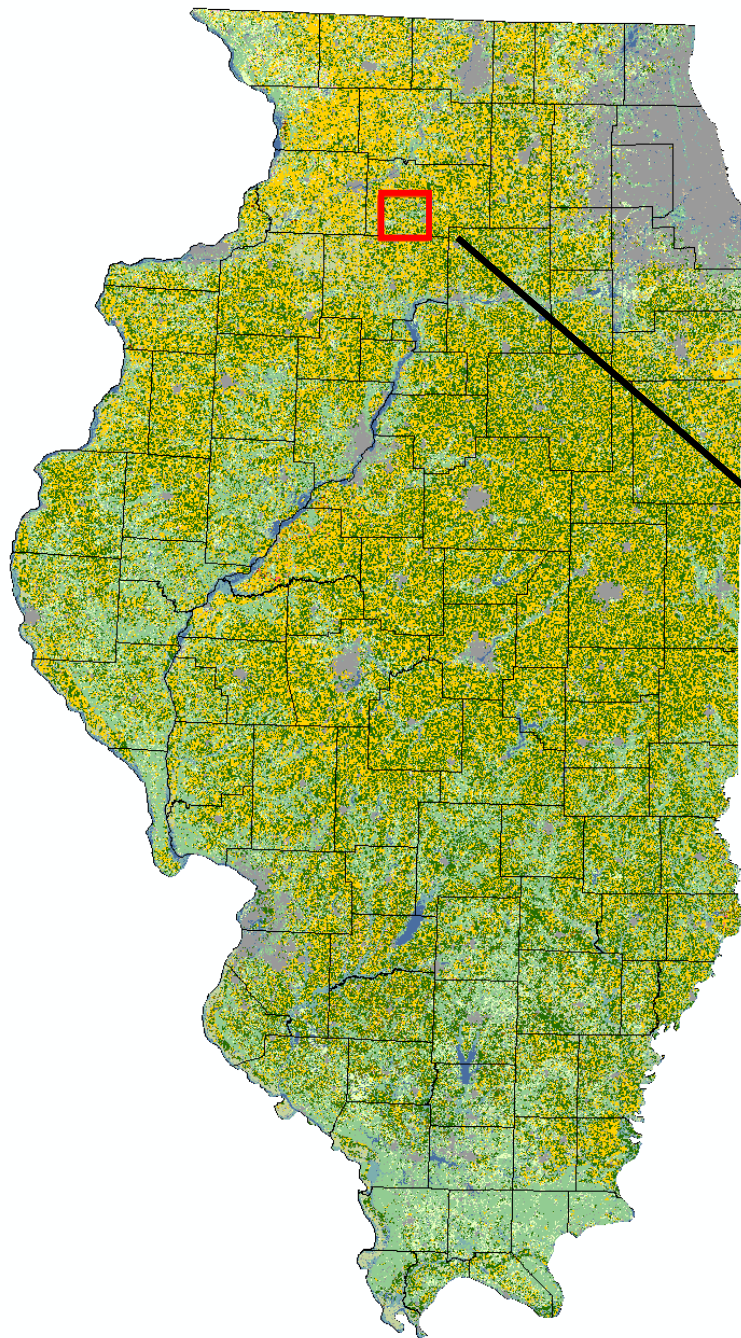


# USDA/NASS utilization of Planet biweekly composites



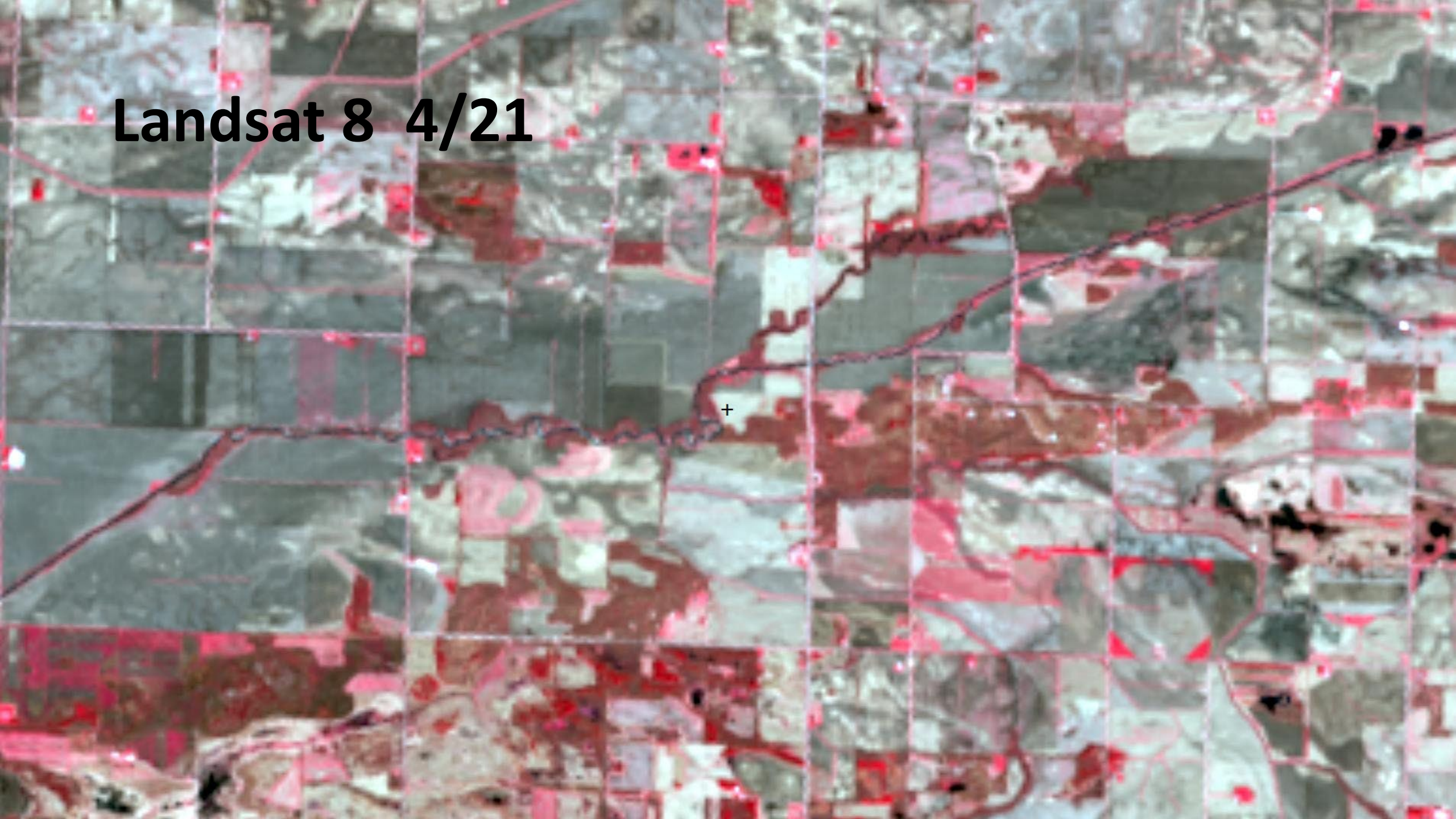


# 2019 Time Series of Optical Imagery Exploration



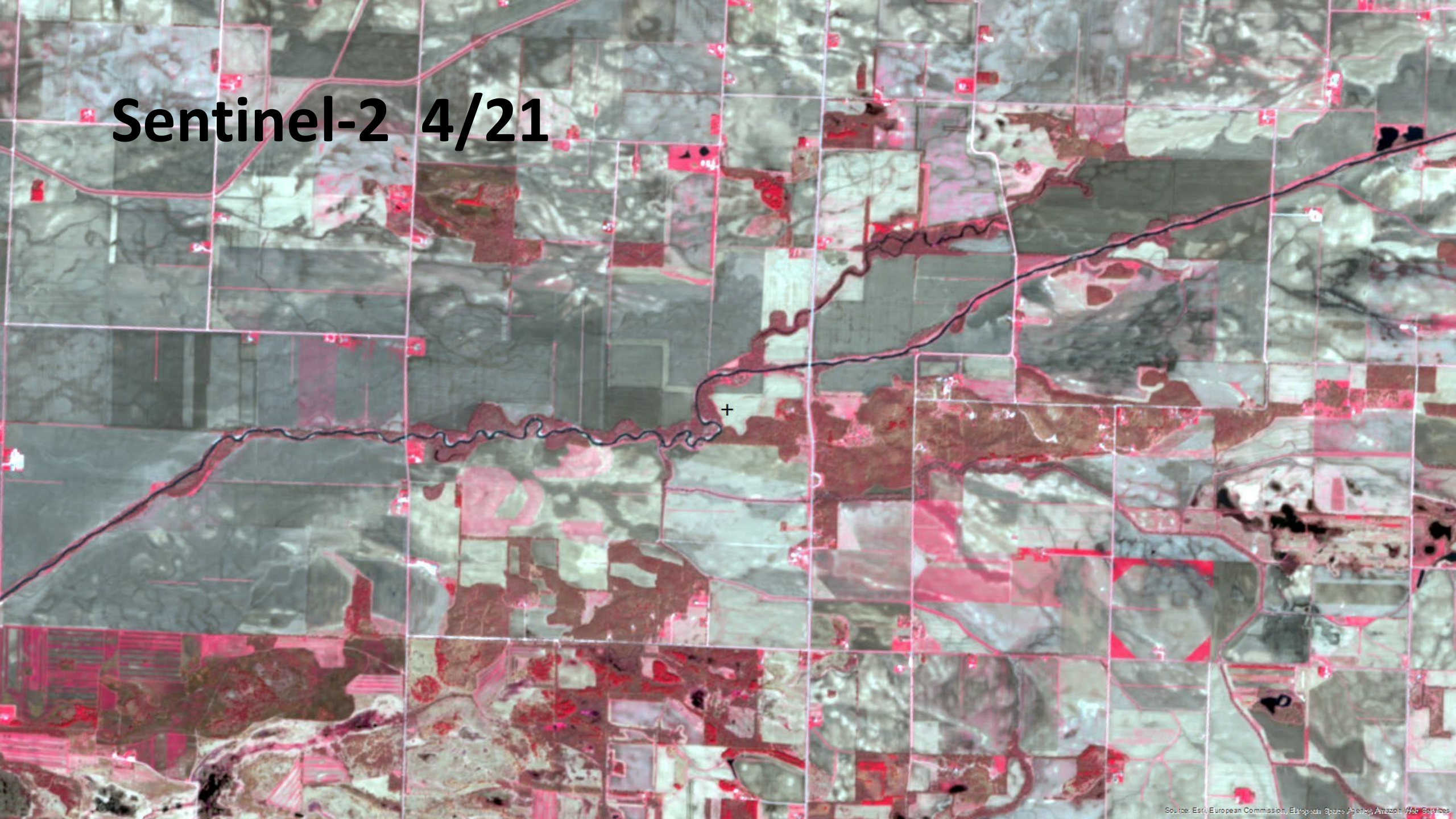


**Landsat 8 4/21**



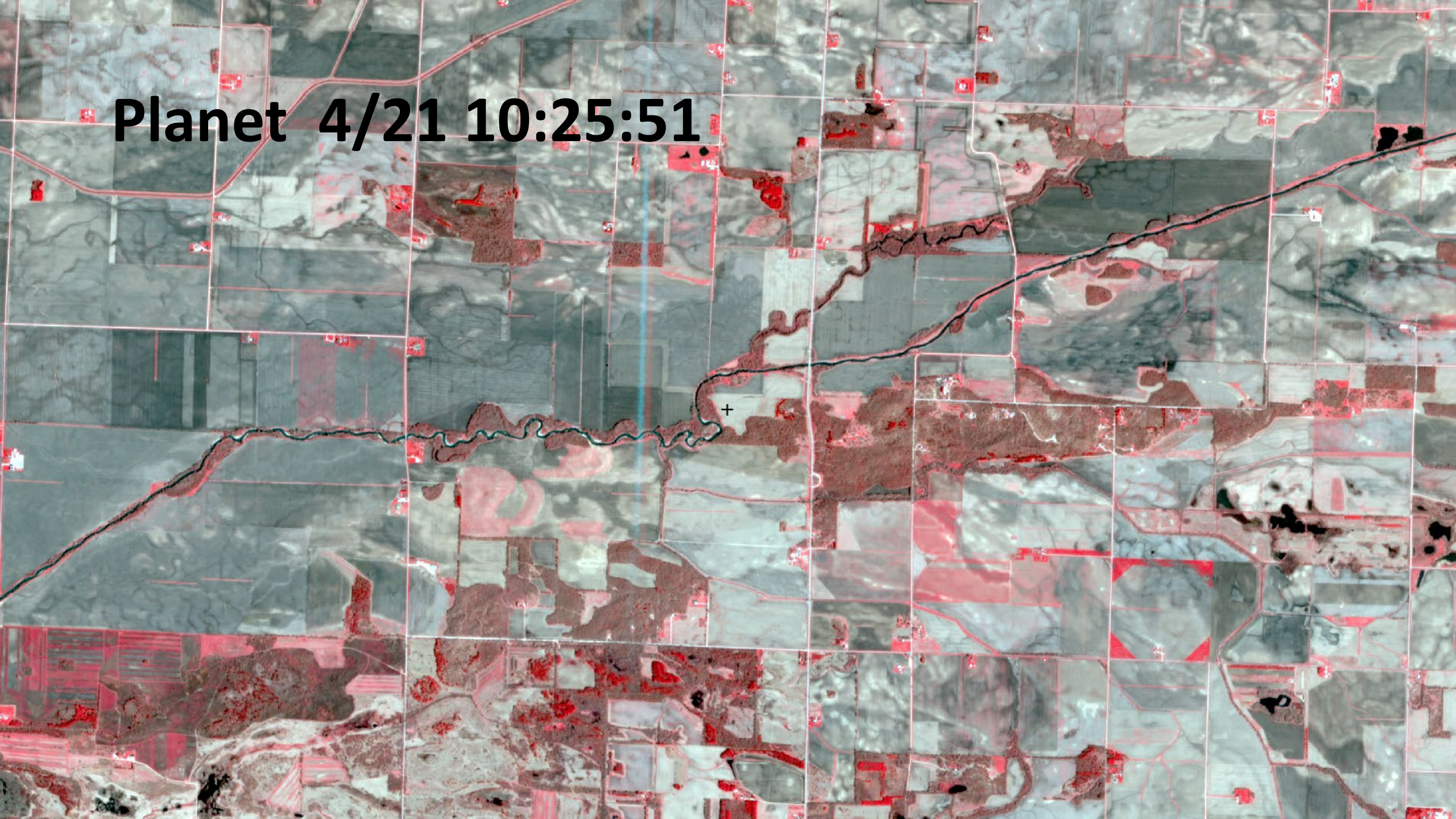


**Sentinel-2 4/21**





**Planet 4/21 10:25:51**



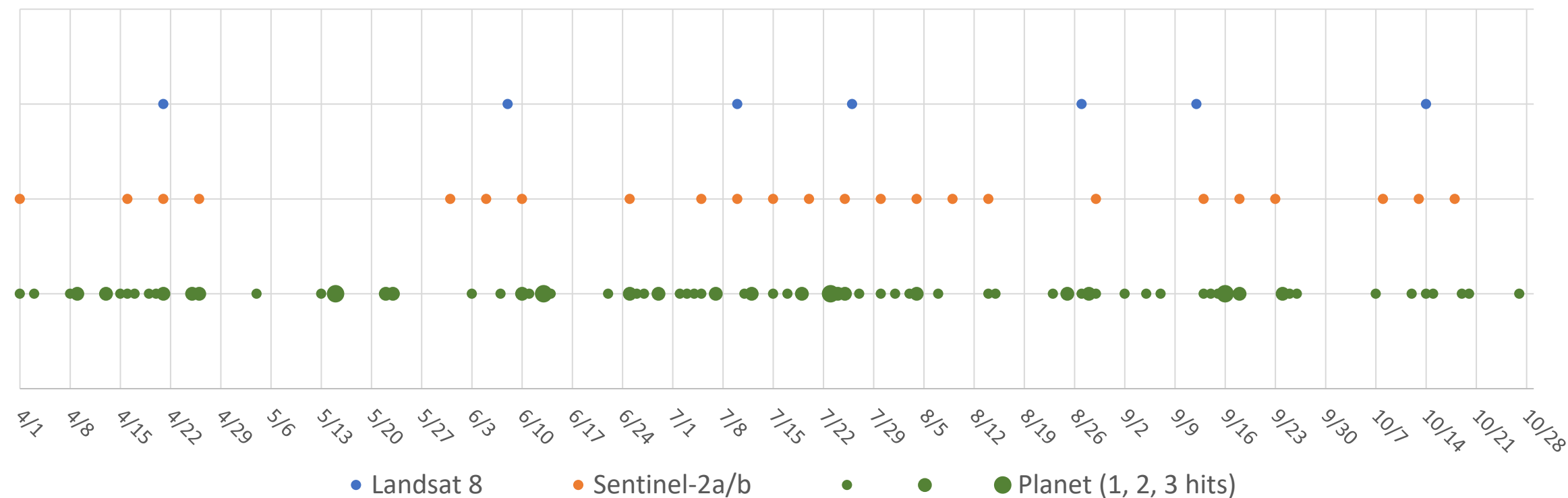


**Planet 4/21 11:23:24**





# 2019 imagery acquisition timeline over study area

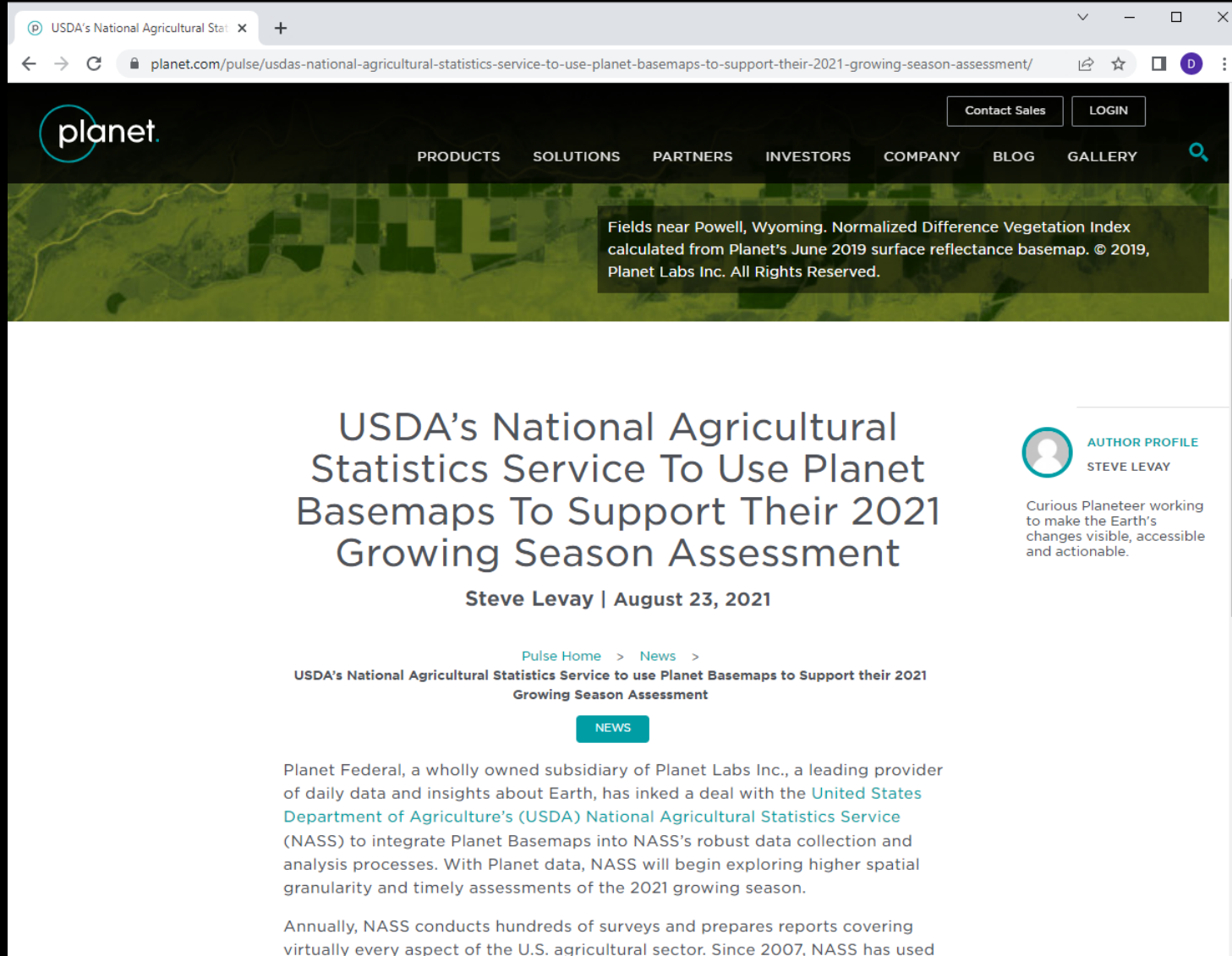


Revisit rates needs are finally being met!



Last year

# Planet 2021 biweekly composites



The screenshot shows a web browser window displaying a Planet Labs blog post. The browser's address bar shows the URL: [planet.com/pulse/usdas-national-agricultural-statistics-service-to-use-planet-basemaps-to-support-their-2021-growing-season-assessment/](https://planet.com/pulse/usdas-national-agricultural-statistics-service-to-use-planet-basemaps-to-support-their-2021-growing-season-assessment/). The Planet Labs logo is in the top left, and navigation links for PRODUCTS, SOLUTIONS, PARTNERS, INVESTORS, COMPANY, BLOG, and GALLERY are in the top right. A hero image of a green field with a text overlay reads: "Fields near Powell, Wyoming. Normalized Difference Vegetation Index calculated from Planet's June 2019 surface reflectance basemap. © 2019, Planet Labs Inc. All Rights Reserved." The main article title is "USDA's National Agricultural Statistics Service To Use Planet Basemaps To Support Their 2021 Growing Season Assessment" by Steve Levay, dated August 23, 2021. The author's profile is shown on the right with a bio: "Curious Planeteer working to make the Earth's changes visible, accessible and actionable." The article content begins with "Planet Federal, a wholly owned subsidiary of Planet Labs Inc., a leading provider of daily data and insights about Earth, has inked a deal with the United States Department of Agriculture's (USDA) National Agricultural Statistics Service (NASS) to integrate Planet Basemaps into NASS's robust data collection and analysis processes. With Planet data, NASS will begin exploring higher spatial granularity and timely assessments of the 2021 growing season. Annually, NASS conducts hundreds of surveys and prepares reports covering virtually every aspect of the U.S. agricultural sector. Since 2007, NASS has used

USDA's National Agricultural Statistics Service To Use Planet Basemaps To Support Their 2021 Growing Season Assessment

Steve Levay | August 23, 2021

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USDA's National Agricultural Statistics Service to use Planet Basemaps to Support their 2021 Growing Season Assessment

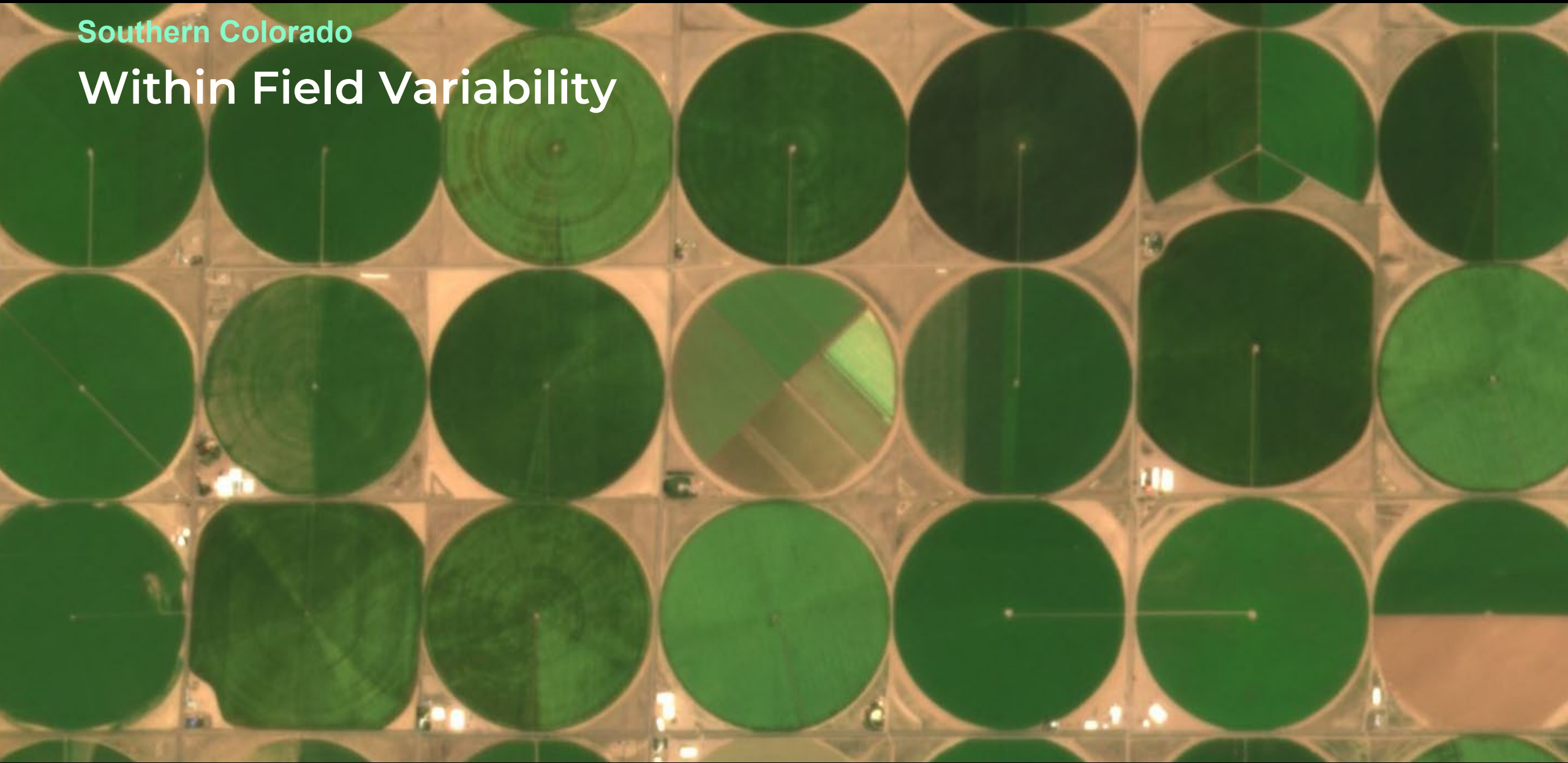
NEWS

Planet Federal, a wholly owned subsidiary of Planet Labs Inc., a leading provider of daily data and insights about Earth, has inked a deal with the [United States Department of Agriculture's \(USDA\) National Agricultural Statistics Service \(NASS\)](#) to integrate Planet Basemaps into NASS's robust data collection and analysis processes. With Planet data, NASS will begin exploring higher spatial granularity and timely assessments of the 2021 growing season.

Annually, NASS conducts hundreds of surveys and prepares reports covering virtually every aspect of the U.S. agricultural sector. Since 2007, NASS has used

Southern Colorado

# Within Field Variability





An aerial night photograph of a large, dark green field. The words "GOD BLESS AMERICA" are faintly visible in the center of the field. To the left, there is a bright, illuminated area that appears to be a parking lot or a small town. The overall scene is dark, with some lights visible in the background.

Western Ohio

# Variable Seed Planting

9 August 2021

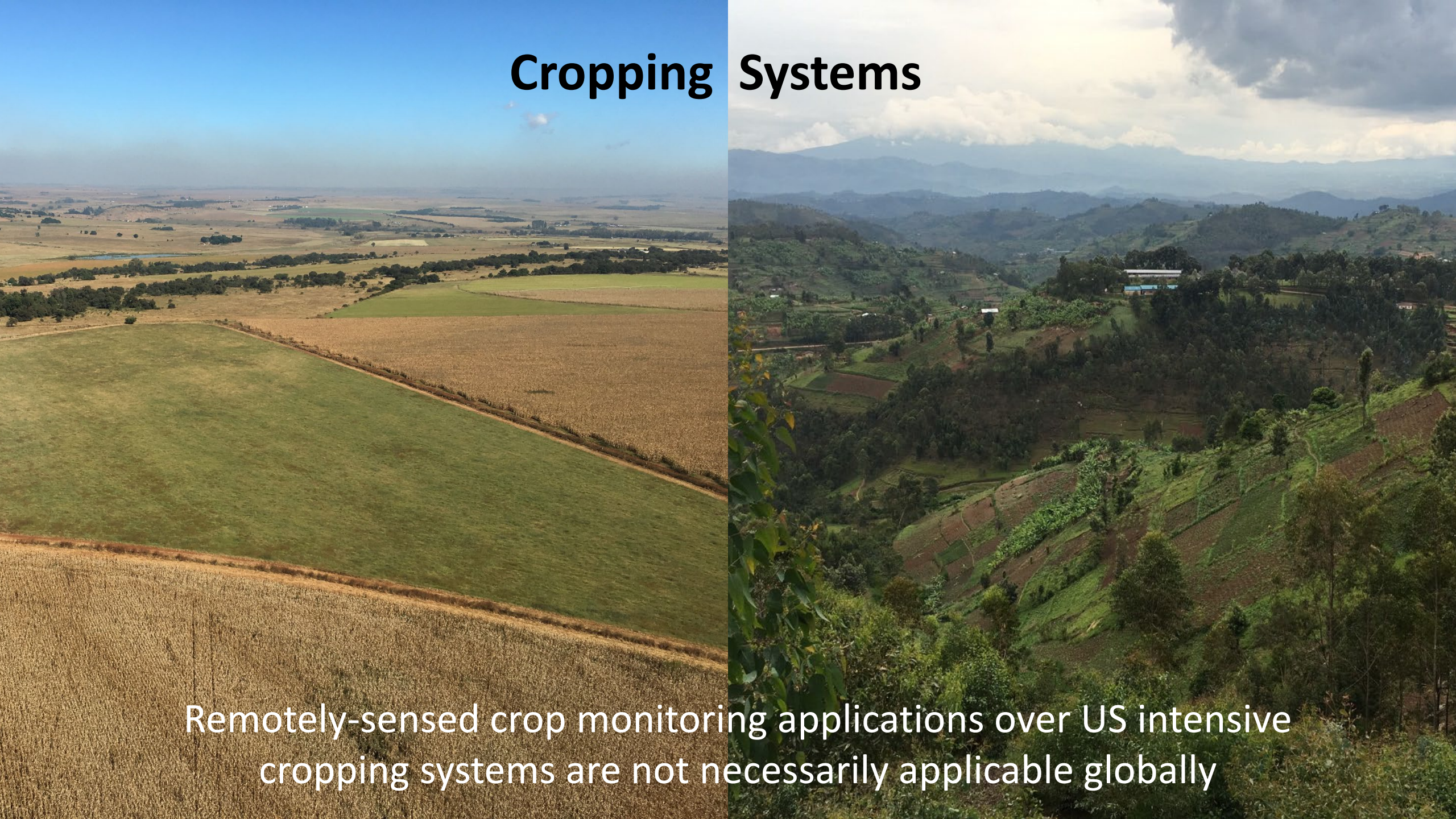
Planet data and Earth Engine

# Fine-scale Crop Type Identification





# Cropping Systems



Remotely-sensed crop monitoring applications over US intensive cropping systems are not necessarily applicable globally